Alternative Field Methods to Treat Mercury in Soils

Technology Need:

Numerous DOE sites, such as the Y-12 National Security Complex in Oak Ridge Tennessee, have soil and sediments contaminated with mercury among other metals and radionuclides. Cost effective, in situ treatment technologies are needed to remove or stabilize this contamination. The baseline method for treatment of mercury contaminated soil at Y-12 is low temperature thermal desorption, followed by on-site landfill disposal. Low temperature thermal desorption is relatively expensive (estimated cost is $740/cy at Y-12), does not treat non-volatile metals or radionculides, and is strictly an ex situ technology. Ex situ treatment of soil that potentially contains free-liquid mercury poses many challenges during excavation and handling. Such challenges include controlling potential mercury vapors and containing liquid mercury beads.

Technology Description:

For this project, IT Corporation teamed with Nuclear Fuels Service (NFS) to demonstrate two proprietary amalgamation/fixation processes for the treatment of mercury, metals, and radionuclides. IT and NFS have both developed their own amalgamation/fixation chemistries that are similar in nature, but are two distinct "chemistries." The NFS process is more mature and has been commercialized under the name DeHg® (pronounced "DEE-merc"). Both processes are ambient-temperature process that convert mercury to a non-hazardous final waste form, suitable for land disposal. The DeHg® stabilization process utilizes amalgamation, sulfide-based reagents, and several other proprietary compounds as the primary mechanism for reducing the leachability of the mercury, RCRA metals, and radionuclides. Portland cement or other drying agents may be used in the stabilization process to solidify liquid wastes and to reduce leachability of other metals. Originally developed in the early 1990s, DeHg® has been successfully demonstrated for the stabilization of a variety of DOE, mercury-bearing wastes, including soil, debris, spent ion exchange resin, and radioactively contaminated elemental mercury, to the TCLP Universal Treatment Standard (UTS) of 0.025 mg/l.

The technology can be implemented *in situ* using an auger system (shown in Figure 1.) that provides effective mixing between the contaminated soil and stabilization agents. The process can also be accomplished ex-situ using a pug-mill system. For *in situ* application, the treatment zone is contained laterally using sheet pile walls. Treatment chemicals are injected through the auger as a liquid or slurry. The total volume increase due to the addition of stabilization agents is typically about 10 percent.

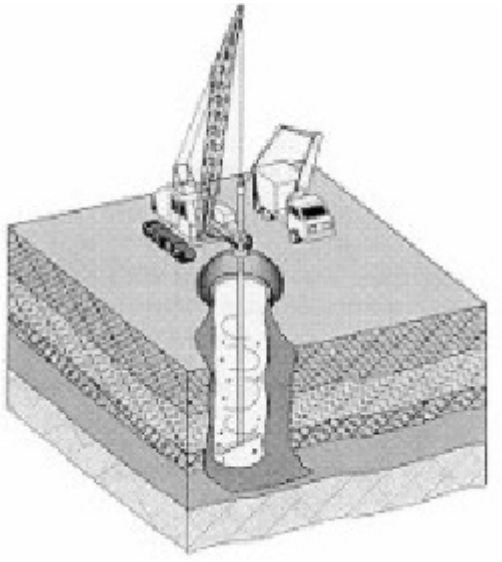

Figure 1. *In situ* mixing using crane-mounted auger

Benefits

- Capable of reducing concentration of mercury in TCLP leachate to below 0.2 mg/l.
- Reported to cost one-half that of the baseline (low temperature thermal desorption).
- Applicable to various forms of mercury, metals, and radionuclides.
- Reduces exposure to mercury and potential release during handling through *in situ* treatment.

Status and Accomplishments:

This project was initiated in October 2001, and Phase I was completed in August 2002. In Phase I, the IT/NFS team performed bench-scale testing on mercury-contaminated soil collected from the Y-12 Site. In Phase I, both IT and NFS successfully stabilized the Oak Ridge, Y-12 soil to the target TCLP limit of 0.2 mg/l Hg and UTS of 0.025 mg/l Hg. The contaminated soil from Y-12 contained less mercury than expected (only 50 mg/kg total Hg) and met TCLP limits untreated. The soil was also very high in clay content. Due to the lower than expected mercury levels, IT and NFS spiked the soil with both elemental and mercuric oxide (HgO). The highest spike level was accomplished by adding approximately 5,000 mg/kg metallic Hg and 100 mg/kg HgO, which yielded a TCLP concentration of 2 mg/l. IT performed its tests using individual samples weighing less than 1 kg, while NFS performed its testing using larger sample batches weighing approximately 21 kg. IT and NFS developed optimum chemistries for each spike level and projected treatment costs of $163/cy for IT's process and $193/cy for the NFS process, based on *in situ* treatment of approximately 50,000 cy of soil.

Prior to this project, NFS has successfully completed a number of treatability studies, and pilot scale tests using the DeHg® process on various mercury bearing wastes from DOE sites. Brief descriptions of these projects are provided below; the sponsoring organization(s) are stated first for each bullet.

- DOE Mixed Waste Focus Area (MWFA) and Oak Ridge National Laboratory (ORNL): Demonstration of DeHg® process for stabilization of an anion exchange resin from the Paducah Gaseous Diffusion Plant contaminated with radionuclides and various metals, including mercury.
- DOE-MWFA and ORNL: Demonstration of the DeHg® process for the stabilization of surrogate wastes comprised of sand with eight different chemical forms of mercury. The total mercury concentration in this surrogate waste was less than 260 ppm.
- DOE-MWFA and ORNL: Demonstration of the DeHg® process as a potential alternative to retorting of mercury using soils from Brookhaven National Laboratory containing greater than 260 ppm mercury.
- Los Alamos National Laboratory (LANL), Chemical Waste Management: Treatability study to evaluate the DeHg® process for treatment of various mercury-bearing wastes.
- Fernald Environmental Restoration Management Company: Bench-scale and pilot-scale treatability study on a variety of mercury-contaminated wastes.

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Online Resources:

Office of Science and Technology, Technology Management System (TMS), Tech ID No. 3166
http://ost.em.doe.gov/tms

The National Energy Technology Laboratory Internet address is http://www.netl.doe.gov